Microbial treatment and characterization of animal waste residues from a slaughterhouse in Bulgaria

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Enormous quantities of hard degradable fibrous proteins containing animal wastes are generated every year from the meat industry worldwide. Unprocessed animal wastes are considered as potentially hazardous biological material due to the presence of blood borne pathogens. Proper treatment of animal wastes aiming to reduce their health hazards and environmental impact is currently important issue for EU countries. Considering high protein content of animal wastes in particular feathers, they have a great potential for different applications. Microbial treatment of animal wastes using thermophilic microorganisms in particular thermophilic actinobacteria represent an attractive alternative for improved utilization of these hard degradable wastes.

- *Types of wastes and processing*. Chicken feathers, bones and skin, and goat horns were provided by a slaughterhouse near the city of Sofia, Bulgaria. The fresh waste residues were pre-treated twice in autoclave (at 134^{o}C and pressure 2 atm. for 50 min) discarding fatty waters. After drying at 105^{o}C for 24 h, the wastes (fresh and pre-treated) were grinded/milled and sieved to obtain a powder containing particles with dimensions less than 1-2 mm.

- *Analyses of wastes performed*. The waste residues (fresh and pre-treated) were analyzed for protein content, total organic carbon, nitrogen, fat, ash and element content, humidity, pH, electrical conductivity, pepsin digestibility, and microbiological analysis. The results revealed that of the tested samples, chicken feathers are characterized by the highest protein and nitrogen content, high content of sulfur, and lower content of heavy metals and toxic elements.

- *Microbial treatment of wastes and characterization*. The Antarctic bacterial strain *Thermoactinomyces sacchari* was selected based on preliminary screening of a collection of thermophilic actinobacteria to utilize 0.7% pre-treated chicken feathers as a sole carbon and nitrogen source. The selected strain was used for testing biodegradability of the wastes (1% of both fresh and pre-treated), and optimal conditions of biohydrolysis of each waste sample were established. Best biodegradability results based on the yield of soluble protein were obtained with chicken feathers: more than 80% of the wastes were converted into soluble products. High content of low-molecular peptides and amino acids was determined in the solutions obtained from biohydrolysis of each waste, thus could be considered important for stimulating plant growth. Heavy metals are present in low amounts that are safe for plants and soils, and no toxic heavy metals (As, Pb, Cd, Cr) were detected. Pellet represents semi-degraded protein and could be a useful source of organic matter in order to be added to the soils. No significant difference in the parameters checked was established between fresh and pre-treated waste samples. Biostimulant effect of the obtained microbial hydrolysates was demonstrated in microcosm experiments with plants (peas and tomato). Therefore, the proposed method of biohydrolysis by selected thermophilic actinobacterial strain is effective for improved animal wastes utilization to obtain value added end products for being used in the agriculture.

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